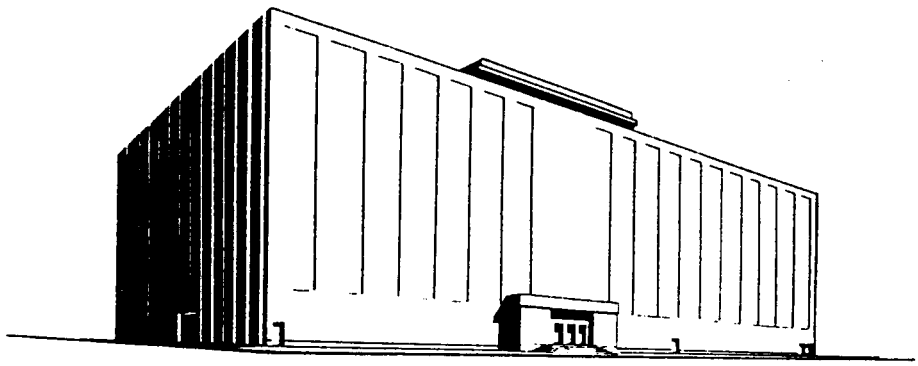


History of

U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY

for the year

1960

This document is designed to serve the dual purpose of
Command History and Annual Administrative Report

SAN FRANCISCO CALIFORNIA

HISTORY

OF

THE UNITED STATES NAVAL RADIOLOGICAL DEFENSE LABORATORY

1960

TABLE OF CONTENTS

PHOTOGRAPHS

CHAPTER I -- 1960 - A YEAR OF CHANGE

PROPER ROLE OF THIS LABORATORY

Early in 1960 a study was conducted at the Washington level regarding the proper role of the U. S. Naval Radiological Defense Laboratory in the national research picture. In June a decision was reached -- NRDL should stay in the Navy family and should remain under the aegis of the Bureau of Ships.

As a result of this study, the Laboratory and its status are now understood in the highest levels of the Department of Defense. The true value of NRDL to the military was given focus in 1960.

"I RELIEVE YOU, SIR"

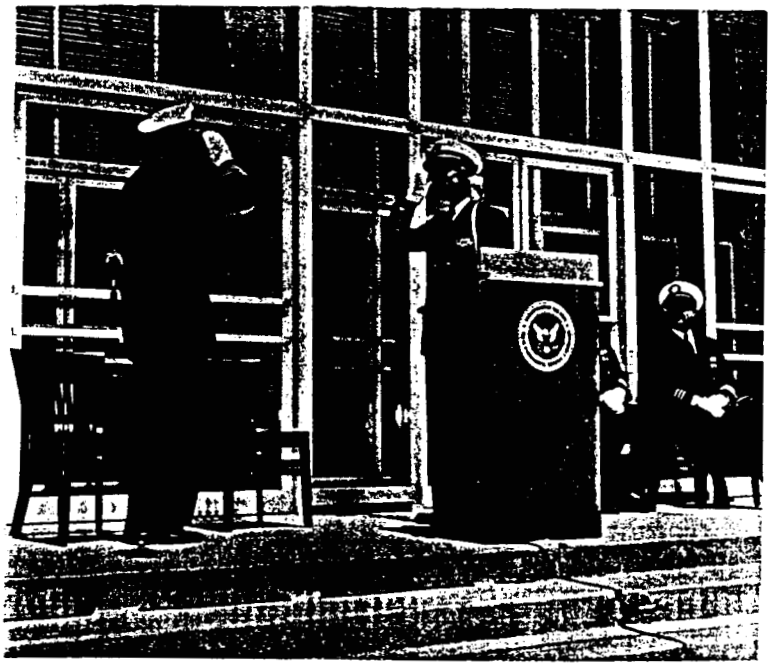
MEET CAPTAIN ROTH

On 19 July CAPT John H. McQuilkin, USN, turned over command of the Laboratory to CAPT Eli B. Roth, USN. Captain Roth is the eighth officer to head NRDL and the fifth to bear the title Commanding Officer and Director. Captain McQuilkin went to the Bureau of Ships as Director of the Ship Design Division.

Captain Roth, a native of New York, was graduated from the Naval Academy in 1939 and immediately joined the Fleet as a junior line officer. During the early part of World War II, he was CO of two ships in the Caribbean, and from 1943-44 served as CO of the destroyer escort Wilhoite in the Atlantic and Pacific. He attended the Naval War College in 1945, spent the next year as navigator of the heavy cruiser Columbus, and then entered the Naval Postgraduate School for the course in Mechanical Engineering Design (Nuclear).

From 1948-51 he was with the AEC at Chicago and Oak Ridge engaged in the design, development, and test of the Nautilus Plant. The next two years he was with the Office of the Secretary of Defense, on the staff of the Research Division, Military Liaison Committee on Atomic

CAPTAIN J. H. McQUILKIN, COMMANDING OFFICER AND DIRECTOR
28 October 1957 - 19 July 1960



"I RELIEVE YOU, SIR" -- Change of Command Command Ceremony, 19 July 1960. Captain E. B. Roth (right) relieves Captain J. H. McQuilkin.

CAPTAIN E. B. ROTH, COMMANDING OFFICER AND DIRECTOR

Energy. He was AEC Project Officer for a nuclear-powered carrier plant in the Naval Reactors Branch during 1953-54, the Shop Superintendent of the Portsmouth Naval Shipyard until early 1958. He spent 1958 and 1959 as Head of the Naval Facilities Branch of the Bureau of Ships and prior to coming to NRDL attended the Industrial College of the Armed Forces.

An article by CAPT Roth, "Atomic Power, Where Will It Pay First?" appeared in the USN Institute Proceedings, October 1953. He is a member of the American Society of Mechanical Engineers. He holds the following Service Medals: two Navy Commendation Ribbons, Presidential Unit Citation; China Service Medal; American Defense Service Medal, one star; American Campaign Medal; European-African-Middle Eastern Campaign Medal; Victory Medal World War II; Navy Occupation Medal; and National Defense Service Medal. Captain Roth is married and has three daughters.

NEW SCIENTIFIC DIRECTOR

Dr. Eugene P. Cooper was appointed Scientific Director in June when Dr. Paul C. Tompkins was selected as Director of Research for Radiological Health with the Public Health Service, Bureau of State Services of the Department of Health, Education, and Welfare. Since 1953 Dr. Cooper had served as Associate Scientific Director. He came to NRDL in 1951 as Head of the Special Operations Division. A native of Somerville, Mass., Dr. Cooper, a physicist, received a B.S. degree from the Massachusetts Institute of Technology in 1937. In 1941 he received his Ph.D. degree at the University of California. Prior to joining the NRDL staff, he was Associate Head of the Underwater Ordnance Dept., Naval Ordnance Test Station, Pasadena, Calif. He previously held professorships at the Universities of North Carolina and Oregon and was engaged in research at the Franklin Institute, Philadelphia. He is a member of the American Physical Society and the American Association for the Advancement of Sciences. Dr. Cooper is married and has four children.

Dr. E. P. Cooper, Scientific Director

Mr. W. E. Strope, Associate Scientific Director

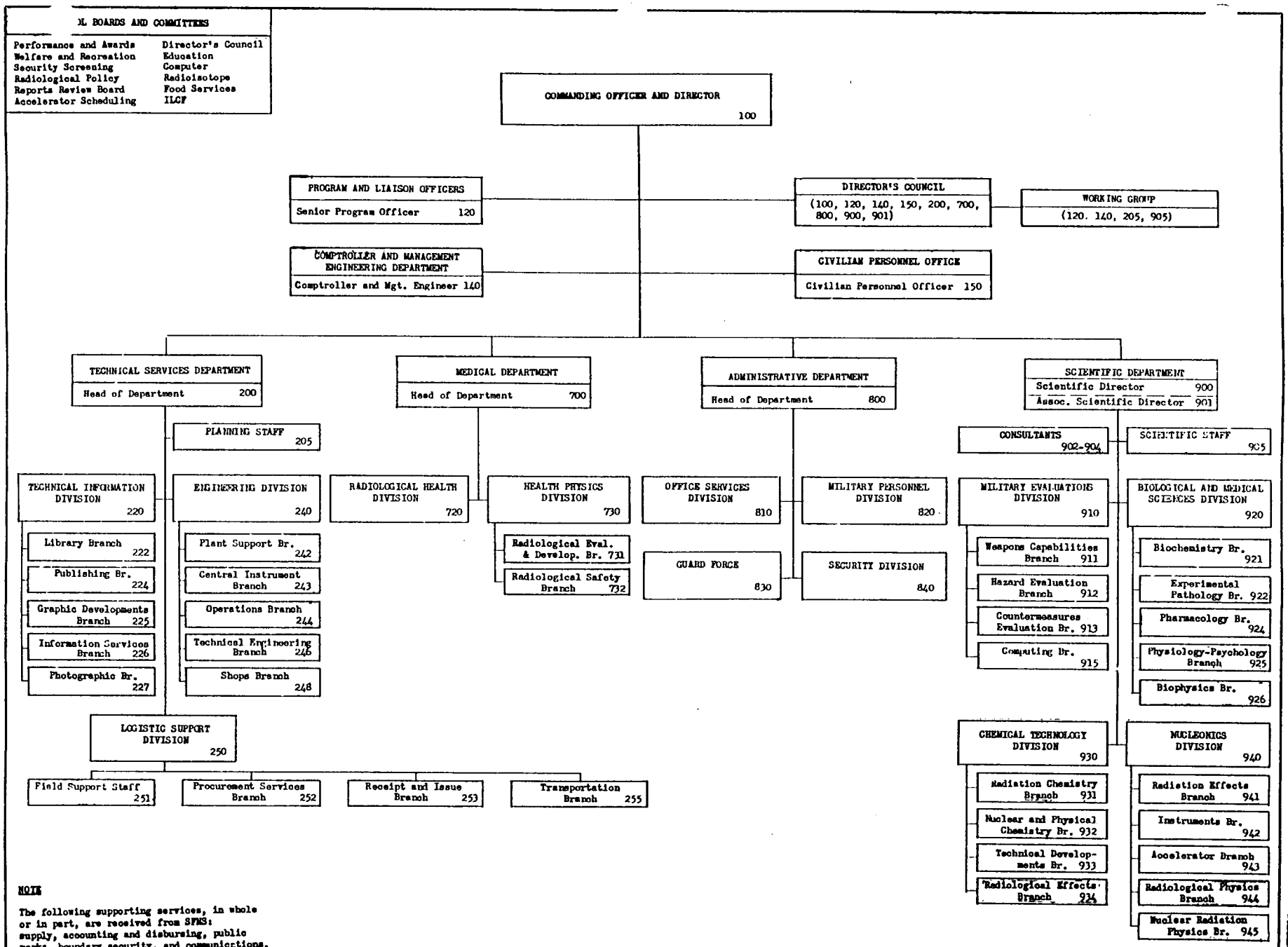
OTHER MAJOR PERSONNEL CHANGES

Mr. Walmer E. Strope, Head of the Military Evaluations Division since 1948, was named Associate Scientific Director. He was replaced by Mr. Charles F. Ksanda, formerly Head of the Weapons Capabilities Branch. Mr. Strope was born in Mason, Mich. In 1942 he graduated cum laude from Webb Institute of Naval Architecture, N. Y., and went to work for the Bureau of Ships as a junior engineer. In a year he was made a naval architect and senior civilian in the War Damage Analysis Section. For his excellent contribution toward keeping our wartime fleet in operating condition, he received the Meritorious Civilian Service Award in 1946. He participated in Operation CROSSROADS and upon his return to Washington transferred to the newly formed Atomic Warfare Defense Section. In 1957 Strope was awarded the Navy Distinguished Civilian Service Award for his contributions of an important and far-reaching nature in the field of atomic and nuclear defense.

Dr. C. Sharp Cook became Head of the Nucleonics Division when Dr. Andrew Guthrie resigned to join the staff of the Alameda County State College.

The Head of the Chemical and Technology Division, Dr. E.R. Tompkins, went to London, England, to the Office of Naval Research. Dr. Lewis H. Gevantman was named Acting Head of the Division following a short period when Dr. Carl F. Miller headed the Division prior to joining General Atomics in San Diego. (Dr. Gevantman was made Head of the Division in January 1961.)

Key military replacements include: CDR Thomas L. Birch, USN, relieved CDR W. G. Logan, USN, when he retired. Earlier in the year Logan had relieved LCDR C. O'G Morrison, USN. Lieutenant (W) Chris L. Huettman, USN, replaced LT (W) M. K. Romani, USN, as Security Division Officer. Lieutenant Commander J. C. Bartlett, SC, USN, replaced LT W. R. Guffy, USN, as Head of the Logistic Support Division.



NOTE

The following supporting services, in whole or in part, are received from SFNS: supply, accounting and disbursing, public works, boundary security, and communications.

17 Jan 1961	APPROVED _____ CAPT, USN, COMMANDING OFFICER & DIRECTOR	U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY	BUREAU OF SHIPS	BASIC STRUCTURAL ORGANIZATION	CHART NO. _____

ORGANIZATIONAL CHANGES

The chart on the preceding page shows graphically the organization of NRDL as of 31 December 1960. Changes made during the year include the following:

In April the functions of the Health Physics Division (Code 730) were restated in the interest of clarity, and the Radiological Development Branch (Code 731) was retitled as Radiological Evaluation and Development Branch.

In July the Radiation Characteristics and Effects Branch (Code 941) was retitled as Radiation Effects Branch, and the Nuclear Radiation Shielding Branch (Code 945) retitled as Nuclear Radiation Physics Branch. This was done in order to reflect a transfer of the function of investigating nuclear radiation characteristics and phenomena to the latter group.

In July the Analytical and Standards Branch (Code 935) was disestablished. The functions of this Branch were absorbed by the Nuclear and Physical Chemistry Branch (Code 932).

In August the role of the Engineering Division (Code 240) was redefined with respect to its functions with respect to engineering plans, specifications, and equipment utilization. At the same time the Division's Central Instrument Branch (Code 243) assumed new responsibilities for central equipment issue and the maintenance of custody records.

Also in August, an Office Services Division (Code 810) was established within the Administrative Department, and the former Security and Communications Division redesignated as the Security Division.

PROPOSED REVISIONS TO NRDL MISSION, TASKS AND FUNCTION

During the latter part of 1960, the Mission, Tasks and Functions of the Naval Radiological Defense Laboratory were reviewed. This resulted in a proposal to reword parts of the Mission, Tasks and Function for clarity and to better express the actual scope of the Laboratory effort.

The proposed rewording which was forwarded for approval states: The mission of NRDL is to: "Conduct basic and applied research on nuclear and thermal radiation from nuclear explosions, natural and controlled nuclear processes, and nuclear accidents and incidents, including chemical, physical and biological processes and effects, associated phenomena and dispersion and contaminating effects of radioactive materials. Develop and evaluate radiac devices and systems, shielding equipment and materials, medical countermeasures for modification of the biological effects of radiation, and reclamation and decontamination procedures and countermeasures. Conduct composite evaluations of nuclear situations, including inter-related effects such as blast and shock. Prepare data for technical and operational manuals and training. Develop use of radioisotopes and other tracer techniques in the above technological and scientific areas. Assist all of the Military Services, other Federal Agencies, and Government contractors in assigned areas."

SPECIFIC FUNCTIONS

The specific functions assigned to NRDL in the accomplishment of this mission are as follows:

A. Conduct basic and applied research as follows:

(1) Determine characteristics of thermal and nuclear radiation wherever and whenever occurring and of all radioactive materials.

(2) Determine biological effects of thermal and nuclear radiation.

(3) Determine effects of thermal and nuclear radiation on materials, components, and systems.

(4) Assess hazards of nuclear warfare, and those arising from the peacetime use of nuclear energy, and from nuclear accidents and incidents.

(5) Develop and appraise countermeasures and protective systems for material and personnel against the hazards presented by nuclear warfare, the peacetime use of nuclear energy, and nuclear accidents and incidents. This shall be interpreted as encompassing all aspects up to the provision of prototype equipments.

(6) Develop and evaluate nuclear radiation measurements systems. This shall be interpreted to include studies leading up to the establishment of performance requirements, conception, design, engineering, and preparation of contract plans and specifications suitable for procurement purposes.

(7) Prepare and coordinate effects and hazards studies for situations in which thermal and nuclear radiation considerations predominate.

B. Serve in a consultant status to and accomplish work which may be assigned in all or any of the above phases by all segments of the Department of Defense, Department of Health, Education and Welfare, the Atomic Energy Commission, Office of Civil and Defense Mobilization, and any other interested government agency.

C. Provide information as required in the preparation of training publications, operational doctrine, technical manuals, etc., as pertains to nuclear warfare, the peacetime use of nuclear energy, nuclear accidents and incidents.

D. Plan and participate in field and weapon tests in connection with assigned functions.

E. Provide support to other activities and units of the operating Forces, and Naval Shore Establishment, and Government and private concerns, as directed by competent authority.

CHAPTER II

TECHNICAL ACCOMPLISHMENTS DURING 1960

This synopsis of technical accomplishments during 1960 is presented under the following categories:

(including Facilities and Equipment Acquired)

Weapons Effects and Related Information
Bio-Medical Research and Hazards Evaluation
Shielding
Radiac Systems; Dosimetry
Disaster Control; Civil Defense; Radiological
Recovery of Shore Installations, Ships and Equipment
War Gaming Information, Simulator, Fallout Model
Technical Basis for Operational Doctrine
Operational Capability for Radiological
Contamination Control
Industrial Applications

WEAPON EFFECTS AND RELATED INFORMATION

WEAPON TEST (WT) REPORTS

Except for final resolution of technical details on one report, NRDL action was completed in 1960 on Operation HARDTACK weapon test reports. Final drafts were submitted during the year on:

WT-1619, "Shipboard Radiation from Underwater Bursts."

WT-1621, "Characteristics of the Radioactive Cloud from Underwater Bursts."

WT-1650, "High Speed Streak Spectra of Bomb Light from High Altitude Nuclear Detonations."

HYDRA PROGRAM

General

The HYDRA program is a long-term effort at NRDL with an overall objective, "To analyze and express as functions of yield and depth of burst those radiological effects of underwater nuclear detonations which may be expected to influence fleet operations and ship design." A comprehensive report on the HYDRA Program was presented on 30 September to various members of DOD. The presentation was requested by the Defense Atomic Support Agency (DASA), the primary sponsor of the Program, and was well received.

Underwater Explosion Test Facilities

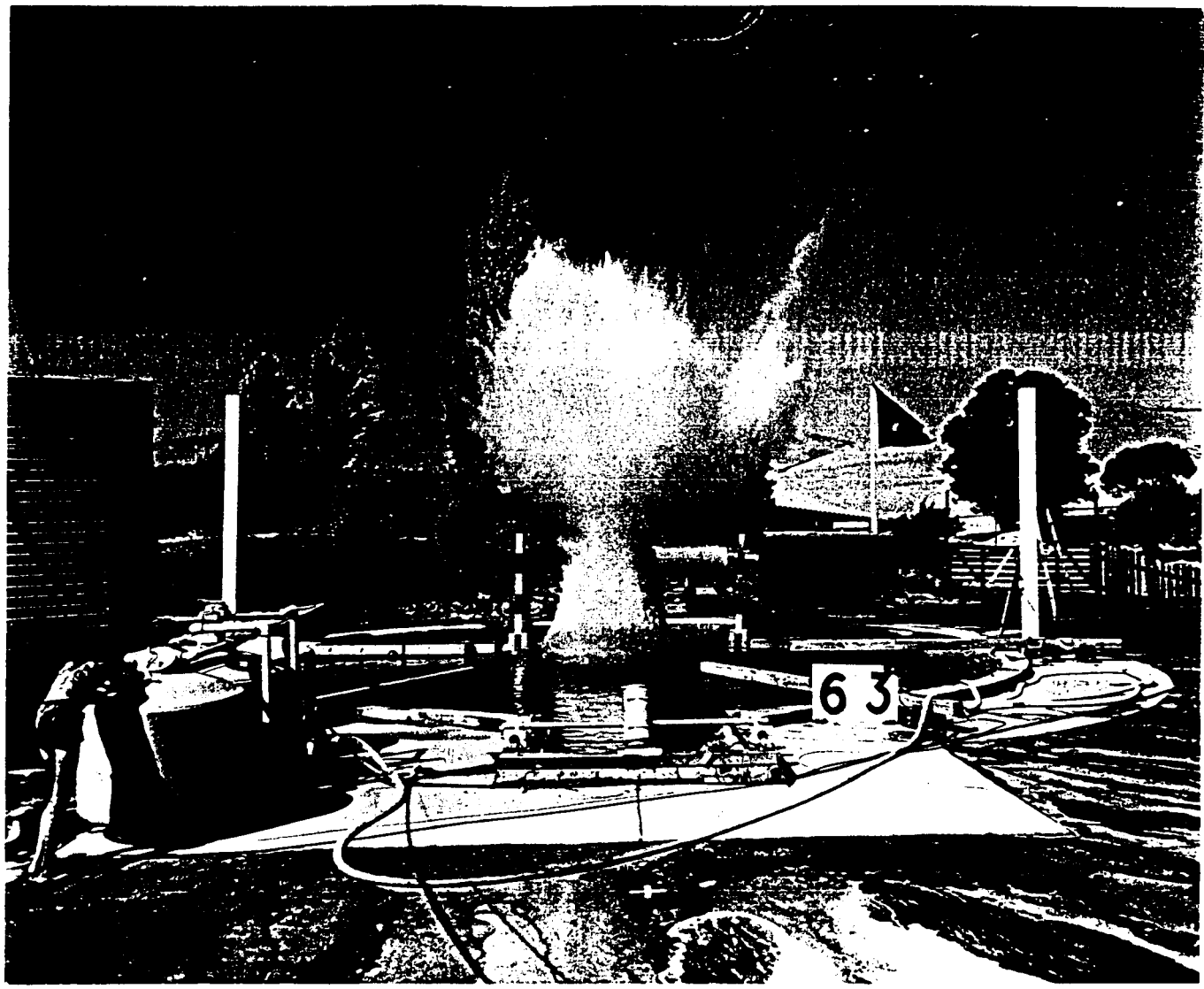
The capability of NRDL to pursue the HYDRA work was made possible by completion of two test facilities:

Outdoor Explosion Test Pond and Camera System at Camp Parks

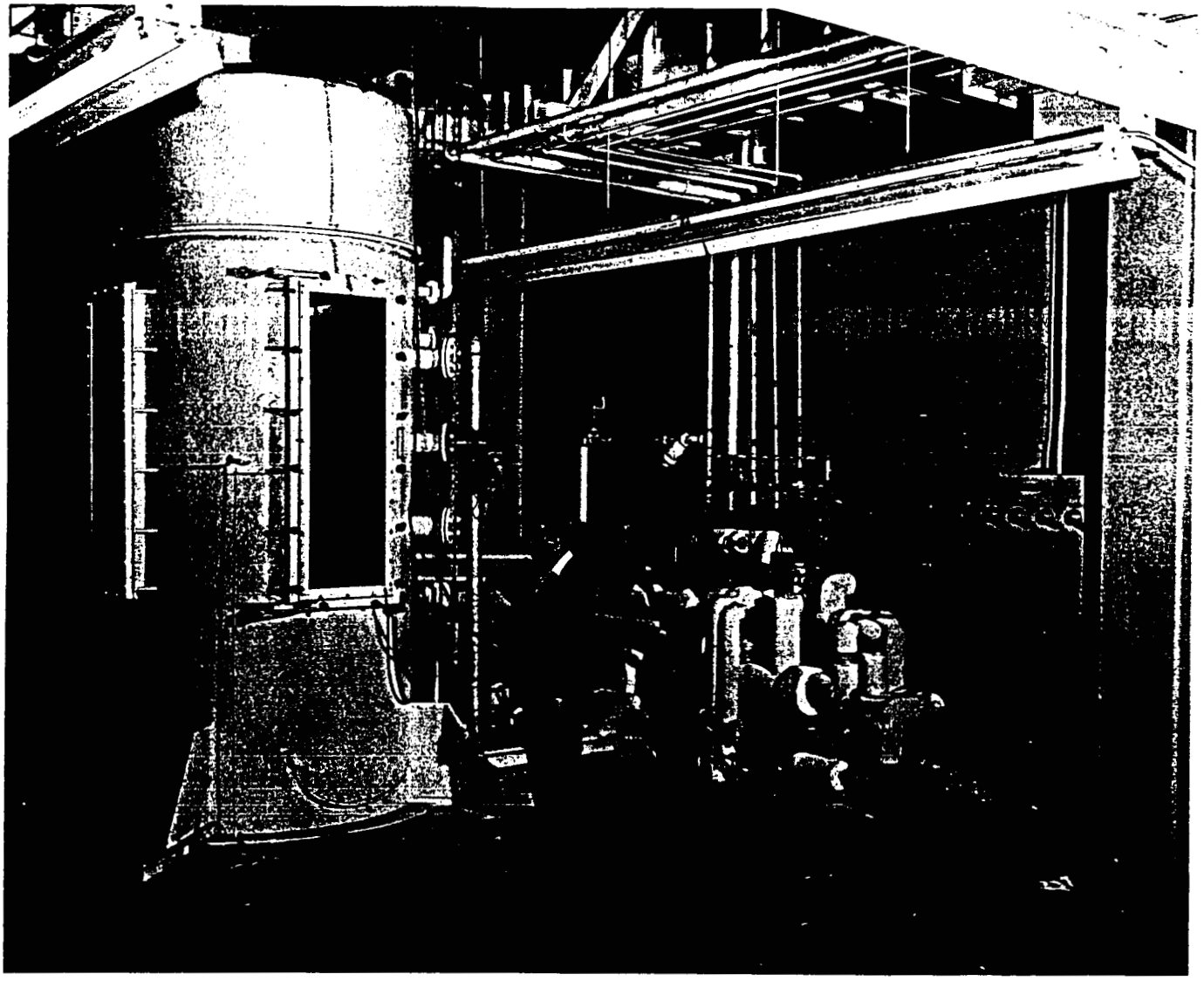
This 18-foot hemispherical explosion test pond was designed for firing various types of high explosive charges as a means of simulating the characteristics of an underwater nuclear detonation. Effects of primary interest are the shock wave and underwater bubble structure and how these affect the water thrown into the atmosphere. Measurements of these effects can be recorded by high speed motion picture cameras, both below and above the surface, as well as electronically through instrumentation.

Laboratory Explosion Tank

This five-foot diameter tank with its height of twelve feet permits the study of above-surface effects as well as underwater bubble dynamics. Explosive charges equivalent to approximately one gram can be detonated and bubble migration can be varied by reducing the atmospheric pressure above the water surface. Photography is accomplished through portholes using an electronically synchronized system to control the detonation, cameras, and lighting. Tracer systems, sampling techniques, and an exploding wire energy source are being developed separately and will be added.



TEST POND AT CAMP PARKS -- A plume of water soars into the air following detonation of conventional high explosive used as a means to simulate the characteristics of an underwater nuclear detonation.



LABORATORY EXPLOSION TANK -- Vacuum tank used for the study of underwater explosions.

ATMOSPHERIC ATTENUATION STUDY

An investigation of the light transmitting and scattering characteristics of a smoggy atmosphere was conducted in the Los Angeles area by a field group from NRDL. The light transmission measurements were made in the visible and near infra-red range with a xenon flash bulb source and photo multiplier detectors, the latter having variable field-of-view and color filter combinations. The light scattering measurements were made with a Pritchard polar nepholometer. The data obtained will be used to calculate the following as a function of wave length:

Attenuation coefficients applicable to collimated light;

"Aureoled attenuation coefficients," that is, coefficients applicable to uncollimated light from a 4π source incident on a flat receiver facing the source;

Ratios of "scattered-in" to "direct" radiation;

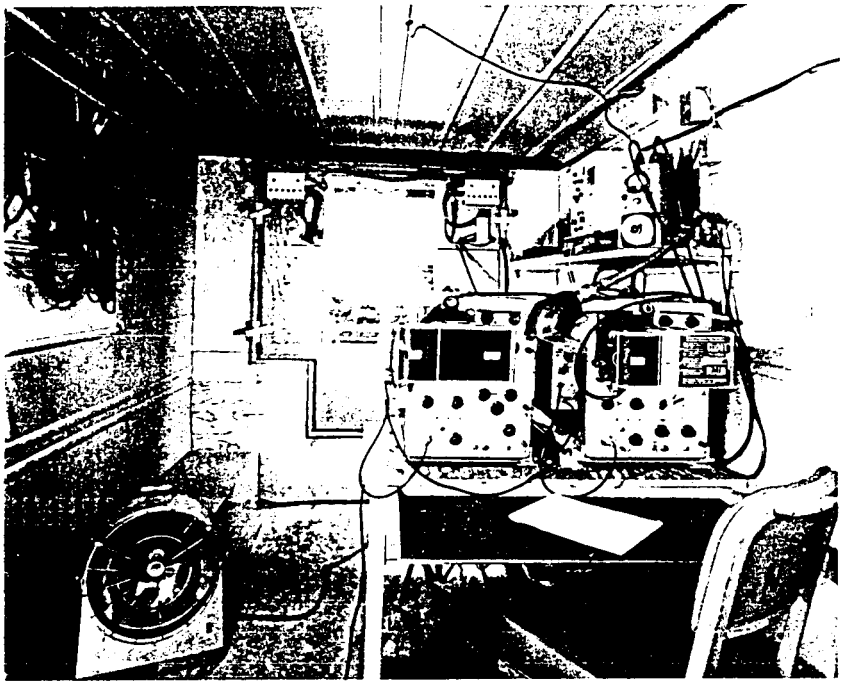
Angular scattering diagrams.

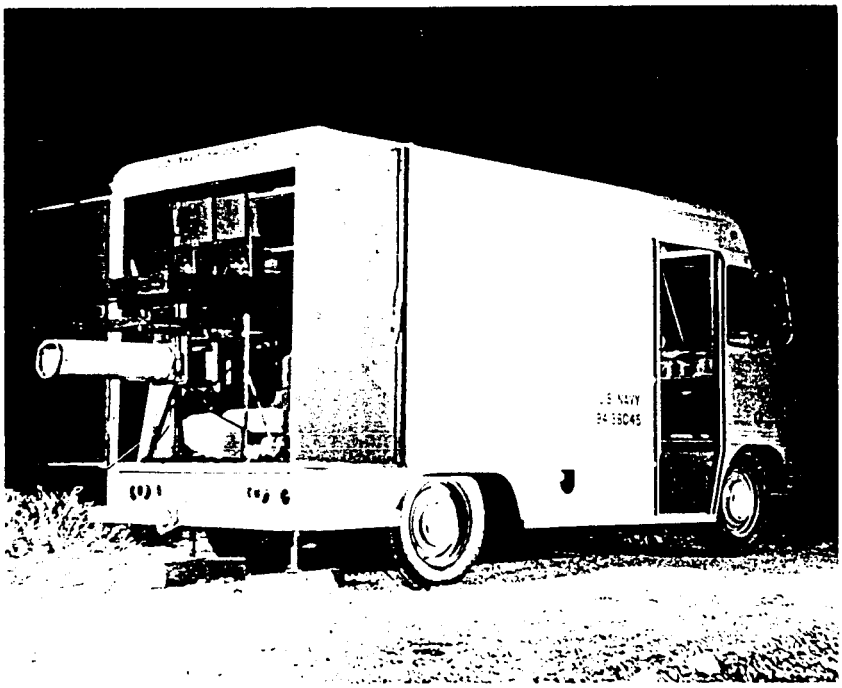
This investigation is the fifth of a series of such experiments performed in various field tests in California and Nevada. The data which have been obtained will be of use in calculating the attenuating effects of various type atmospheres on the thermal radiation of a nuclear weapon as received by a target facing the weapon.

FLASH PYROLYSIS

A basic research program under DASA sponsorship deals with the flash pyrolysis of cellulose. The long range objective of this program is to provide countermeasures to the incendiary consequences, both fire initiation and propagation, of nuclear detonations. The project makes use of carbon-arc, xenon-flashtube and other sources of intense radiant energy. Gas chromatography and time-of- flight mass spectrometry coupled with the more classical techniques of free radical scavenging, chain inhibition and isotopic labeling are utilized to ascertain the fundamental processes involved.

Recent gas chromatography data on the stable pyrolysis products of cellulose exposed (in helium) to the carbon-arc source show that there is a sudden change in evolved gases at the instant when exposure in air





ATMOSPHERIC ATTENUATION STUDY -- "FLASHING LIGHTS" -- Instruments used to determine light transmission measurements.

would result in ignition. Foremost among those substances which either show a marked increase or which first appear, are hydrogen, methane, ethylene, ethane, acetaldehyde, propionaldehyde and biacetyl. These results suggest that ignition occurs in air as a result of an abrupt change in the mechanism of decomposition.

It has been known for some time that certain salts of the alkali metals exert a strong catalytic influence on the thermal decomposition of carbohydrates. Gas chromatography measurements of the pyrolysis products of "salted" cellulose are currently being made to learn the nature of the catalytic influence of such additives.

The present bits of information are insufficient to permit drawing many final conclusions. Information of this sort, however, can point the way to practical countermeasures, to inhibit burning, based on the principles of catalytic inhibition. Success might provide means for reducing danger of material ignition by thermal radiation from nuclear weapons.

U. S. ARMY ANTI-FLASH SYSTEM

Evaluation tests were performed for U. S. Army Ordnance, Frankford Arsenal, on a Battery Commander's M-65 telescope as modified by the addition of a Kerr cell shutter system which operates fast enough to provide observer protection from the intense flash of nuclear weapons even though the flash from the weapon itself initiates the shutter operation. The evaluation tests consisted of measurement of transmission through the telescope of radiant energy from a carbon arc source. A group of filters (polarizing, reflecting and absorption types) were tested for transmission characteristics and ability to resist intense thermal radiation from a carbon arc source. Results were reported in USNRDL-TR-445.

CHARACTERISTICS OF THERMAL RADIATIONS

NRDL prepared a comprehensive summary and analysis of weapon test thermal data which was published in 1960 as DASA-902 (USNRDL-TR-383).

BIO-MEDICAL RESEARCH AND HAZARDS EVALUATION

GENERAL

The Bio-Medical program yielded the following among its highlights in 1960:

Evolution of a new concept, followed by test and proof of its validity, for the accumulation of residual radiation injury.

Acute recovery studies on a number of large animal species has led to a new approach to the problem of continuous or repeated exposure of individuals.

Demonstration that the primary cause of early post-radiation death is loss of sodium via the gastrointestinal tract.

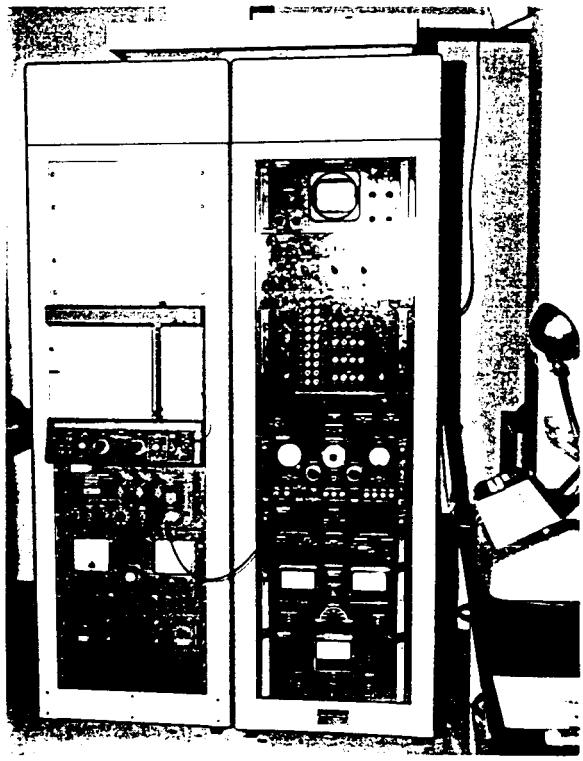
COURSE FOR MEDICAL OFFICERS IN AW, BW/CW DEFENSE

Laboratory personnel participated to a major extent during the period 18-21 January in the course for Medical Officers in ABCD Course conducted by the U. S. Naval Schools Command at Treasure Island. Talks were given by NRDL personnel on twenty topics, and a tour was made of the Laboratory.

LOW BACKGROUND RADIATION COUNTER

The Laboratory is now completing testing and calibration of a new radiation counter which will be capable of detecting and identifying extremely small quantities of radioactivity in humans. A unique feature of this instrument is a 55-ton steel room into which the subject and radiation detecting element will be placed to reduce by a factor of almost 100 the level of background radiation, which would otherwise interfere with such a

IRON ROOM FOR LOW BACKGROUND RADIATION COUNTER -- Scientist adjusts crystal position in preparation for counting subject.



100 CHANNEL PULSE HEIGHT ANALYZER -- Used to record information in the Iron Room

measurement. The output from the detector is analyzed electronically and the results recorded automatically in 100 channels, each representing an energy level of the radioactivity found in the body. An experienced operator can interpret the record to determine the amount and type of activity measured.

In addition to providing a rapid and accurate method for routinely assessing radioactivity in people, this counter will be an important tool in the biomedical research of the Laboratory. Controlled tracer amounts of radioactivity can be introduced into the bodies of human subjects or large animals and its passage measured accurately. One of the results of these studies will be a better understanding of the biological effects of radioactivity when ingested.

This instrument is similar to human counters first developed at the Argonne National Laboratory at Lemont, Illinois, but utilizes a different room design. Six-inch thick pre-World War II armor plate was used in its construction, and precautions were taken in the selection of materials and construction methods to minimize radioactivity in the room structure. Inside dimensions are 8' high by 8' long by 6-1/2' wide. A second shield enclosure, also constructed of 6" thick steel plates, has inside dimensions of 4' high by 3' long by 4' wide and will be used for studies with smaller animals.

LONG-TERM EFFECTS OF ACUTE DOSES OF RADIATION

There is evidence that the general effects of acute radiation exposure are to increase the apparent aging rate of the animal or man exposed. Since humans cannot be used, the experimental work must be done on other mammals and the results translated into meaning for humans. The Laboratory is engaged in a comprehensive series of experiments designed to characterize the irradiated animal during the various stages of its life span. The group is in the Physiology-Psychology Branch of the Biological and Medical Sciences Division. A display summarizing the work to date was enthusiastically received at the meeting of the Radiological Society of North America 4-9 December. It was titled "Long Term Effects of Radiation in an Aging Population of Male Rats." The exhibit presented summaries of some of the measurements made in these studies, including food, water and oxygen consumption, heart rate, body temperature and weight. The increased incidence of tumors following radiation was demonstrated as was the development of radiation type cataracts and dental defects.

SHIELDING

Progress in a shielding technology for predicting shielding effectiveness of complex structures in a variety of complicated weapon radiation fields has permitted calculation of dose distribution within ships for certain situations for weather deck contamination. A Shielding Symposium, held at NRDL in November under joint sponsorship with the Office of Civil and Defense Mobilization, afforded additional opportunity for a critical review of shielding activity throughout the country and the part NRDL's program is to play in fulfilling existing needs for information.

RADIAC SYSTEMS; DOSIMETRY

SHIPBOARD INSTALLED RADIAC SYSTEM AN/SDR-1

The AN/SDR-1 is an installed, remote indicating dose-rate measuring system approved as interim standard for Navy use. This system was developed to provide information on nuclear radiation in tactical situations to aid command decisions. Because of the type of information needed to make these decisions, the system has the following features:

Detector located and readout available in the controlling topside action station.

Range of system is low enough to indicate ship's initial entry into a contaminated area or fallout (0 to 1 mr/hr).

An alarm which can be pre-set for various intensities on the low range (1 mR to 1 R/hr in 4 decades) to warn of entry into contamination.

Range of system to extend high enough to cover the possible high intensities (to 10,000 R/hr).

Remote readout of the high range (1 to 10,000 R/hr in 4 decades) at an evaluation center in the protected (shielded) part of the ship.

The final evaluation of the AN/SDR-1 was completed and reported in April 1960.

IMPROVEMENT IN CADMIUM SULFIDE CRYSTALS

Cadmium sulfide crystals hold great promise as gamma ray detectors for a whole series of simple rugged subminiature radiation monitors varying from individual radiacs to rocket-borne units for remote monitoring. However, the reproducibility of desirable crystals has proven very difficult. Commercially grown CdS crystals are being modified by cyclic exposure of crystals to a variety of vapors and vacuum baking. The sensitivity of single crystals has been permanently improved 30 to 100 fold. This indicates the possibility for controlling the sensitivity of crystals and achieving uniformity of response. Further work on this, if it succeeds, could provide the basic detector for a new class of cheap, small, simple, rugged radiacs.

RGI-20 RECYCLING RATEMETER

The RGI-20 is a miniature radiac system built around the recycling principle. It will provide high range coverage (gamma) from 0 - 1000 rad/hr in three ranges, an external plug-in probe providing beta plus gamma data from 0 - 5000 rad/hr in two ranges, and a low range plug-in unit from 0 - 1000 mr/hr in three ranges (beta-gamma). Other auxiliary detectors, including remote types, can be made as the need arises. The flexibility outlined will be possible because of the use of the recycling technique. The packaging has been as a combat tactical range radiac without compromises in size and weight or in complexity to achieve wide range multiple detector capability.

Work on this unit is in the advanced engineering state and prototypes of the basic module were delivered to BUSHIPS in June, 1960. The complete device will consist of a unit approximately 2" x 5" x 4" weighing less than three pounds and substitute for 2 units each over 5 pounds, not now usable in combat or capable of the high range beta-gamma measurement.

ASSISTANCE RENDERED TO CANADA

LTCOL Donaldson and Mr. Bell of the Canadian Army Development Establishment spent a week at NRDL calibrating a Canadian pool of glass type casualty range (DT-60) standards and discussing production control problems. This new pool consists of 50 elements exposed to CO^{60} radiation and calibrated by comparison with the standards at NRDL (M-pool).

FILM

CNO Naval Research and Development Film Report 1-60

In March, 1960 approximately 600 feet of color film was furnished The Office of Naval Research with a script scenario for use in the NARAD 1-60 portion on Radiac Development. This short sequence covered the manner in which radiacs are developed to satisfy operational requirements for radiological information which is required for Command decisions.

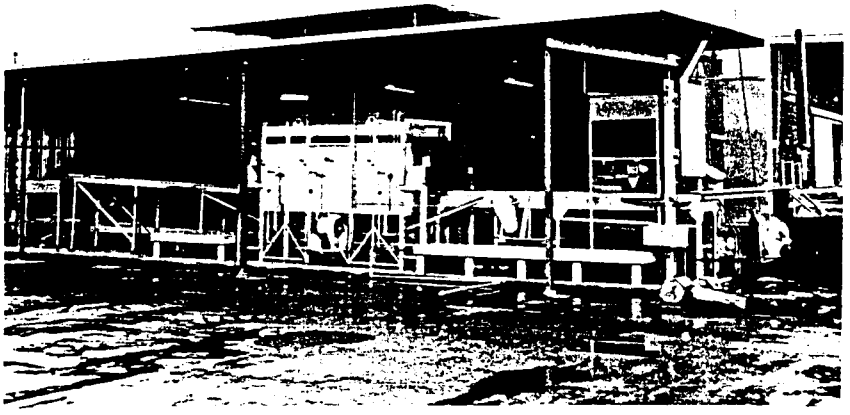
DISASTER CONTROL; CIVIL DEFENSE; RADIOLOGICAL RECOVERY OF SHORE INSTALLATIONS, SHIPS AND EQUIPMENT

LAND FALLOUT FIELD TESTS

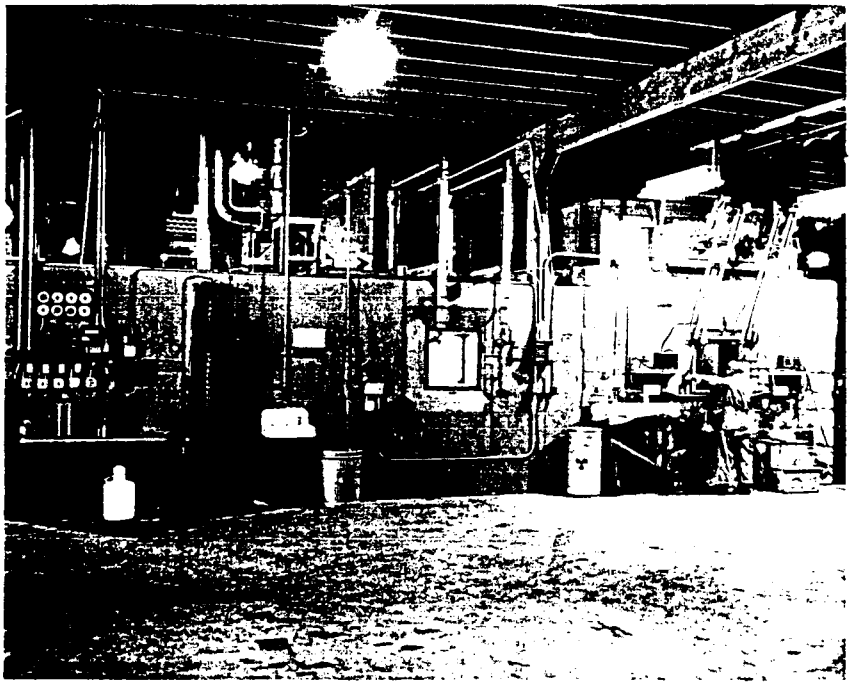
These tests include the removal of radioactive fallout from land areas and proof-test of the methods in large scale operations.

Preparation of Fallout Simulant

Ton quantities of radiotagged fallout simulant are produced in a simple but unique facility at Camp Parks, near Livermore, California.



PRODUCTION OF FALLOUT SIMULANT -- (above) Production area of a tagged sand simulant. (below) Preparatory area for the production of large quantities of radio-tracers.



It consists of a hot cell, enclosing a floor area 8' by 8'; two-yard modified concrete mixers are to prepare the radioactive sand; and a gas-fired refractory lined furnace to heat the final product.

The sand is activated by pumping an assayed quantity of freshly prepared radioactive Ba(140) from the cell to the rotating concrete mixer where it was sprayed on a 500-lb charge of sand. A solution of water glass is they sprayed in to overcoat and sand particles and fix the radioactive tracer to the sand. The batch is then dried by blowing hot air into the concrete mixer. The dry material is transferred to stainless steel pans and pushed into the furnace where it is fired for 1 hour at 1000° C to fuse the silicate coating and seal in the radionuclides.

Some 500 curies of Ba(140) are used in an operation, and about 90 per cent of the potential radiation dose from an equilibrium Ba(140) - La(140) mixture was avoided by separating and discarding the daughter La(140). The synthetic fallout is then stored for 10 days to allow the La(140) daughter to grow in to equilibrium.

Dry Fallout Disperser

This is an indoor facility, also at Camp Parks, for precision dispersal of dry synthetic fallout from a height of about 35' over an area 60' by 80'. The disperser is a pneumatic, multi-nozzled machine using sandblasting techniques to spread dry sand fallout simulant in evaluation of decontamination procedures, and fallout ingress in ventilation systems. Various test surfaces can be mounted on a tilting platform beneath the disperser and subjected to a variety of decontamination processes.

Target Complex Decontamination Experiments

During 1960 two Target Complex Decontamination Experiment were conducted at Camp Parks. Their purpose was to develop and evaluate new and existing methods of decontamination for land areas. For each experiment a complex of four acres including buildings, lawns, sidewalks, paved streets and bare soil was contaminated with artificial fallout to simulate the conditions that would exist following a land surface nuclear burst as follows:

March 1960: Thirteen miles downwind (15 knots) from a 100 KT weapon, fallout particle size of 300 to 500 microns, density of 30 gm/sq. ft. and a radiation level (scaled) of 1,000 r/hr at 1 hr.

ference of these effects on operations; providing estimate of time, manpower, and material required for various degrees of recovery for various states of initial damage; and recommendations for possible actions to aid in alleviating effects of such attacks and expedite recovery.

Reports completed or well underway include:

USNRDL-TR-435 "Estimating Cost and Effectiveness of Decontaminating Land Targets."

A Study for OCDM evaluating the time and effort to conduct repairs resulting from rapid emergency shutdowns in oil refineries.

EFFECTS OF NUCLEAR WEAPONS

This unclassifed DOD-AEC publication serves as a primary reference and comprehensive summary of current knowledge on the effects of nuclear weapons. The Laboratory prepared for the Defense Atomic Support Agency major text revisions to Chapter IX, Residual Nuclear Radiation and Fallout on the sections concerning Fission Products and Technical Aspects of Residual Nuclear Radiation.

SEA WATER FALLOUT CAPABILITY

Operation CASTLE demonstrated that a megaton weapon detonated on the surface over deep water produces fallout with a potential lethal radiation hazard to shipboard personnel. Effective doctrine for nuclear defense at sea requires considerably more information on this hazard and its countermeasures than has resulted from fullscale nuclear weapons tests performed to date. A test facility has been completed at Camp Parks which is designed to generate synthetic sea water fallout by impingement of the simulant upon a rapidly spinning disc. The disperser is remotely controlled and capable of dispersing a seawater fallout simulant at a programmed variable rate representative of the deposition rates of fallout from a real nuclear detonation (water surface of underwater).

Experiments with this facility will be used to develop the following basic data:

Levels to which ships' surfaces are initially contaminated by specific fission fragments or activated elements.

Decay rates of both unaltered fallout and that following decontamination efforts (these vary with composition of fallout, method and start time of decontamination).

Answers to the following operational questions would then be determinable:

Which decontamination method should be selected in the event washdown is not or cannot be used ?

What is the optimum time to start decontamination ?

What size team and how many should be used at any one time ?

Where should decontamination begin ?

How long will it take to reduce the dose rate to a tolerable level ?

What will be the radiation dose to the personnel involved ?

CHAPTER 90, BUREAU OF SHIPS TECHNICAL MANUAL

This chapter was prepared by the Laboratory and issued by the Bureau of Ships in 1960. Its title is "Radiological Recovery of Ships after Nuclear Weapons Explosions." Chapter 90 provides the best available information on shipboard radiological countermeasures and planning for radiological recovery with a minimum of time, effort, and personnel hazard.

Detailed procedures and planning techniques for recovery countermeasures are presented for all degrees of ship contamination in peacetime or wartime.

RADIOLOGICAL TRAINER (DEVICE X11F3)

The Laboratory has been involved in the development of a device capable of spreading short-lived radioactivity for BUPERS managed training programs concerned with radiation and contamination control.

PROTOTYPE FALLOUT SHELTER

The importance of shelters as part of a national radiological defense system was brought out in the June 1959 Congressional Hearings on Biological and Environmental Effects of Nuclear War. These Hearings were based upon a hypothetical but credible attack on the U. S. with a total yield of 1,446 megatons plus an additional 2,500 megatons elsewhere in the northern hemisphere. It was estimated that such an attack under present conditions would kill approximately 50 million Americans with some 20 million others sustaining serious injuries. Of the deaths about 75 per cent would have resulted from blast and thermal effects and initial radiation; 25 per cent of fatalities would result from fallout.

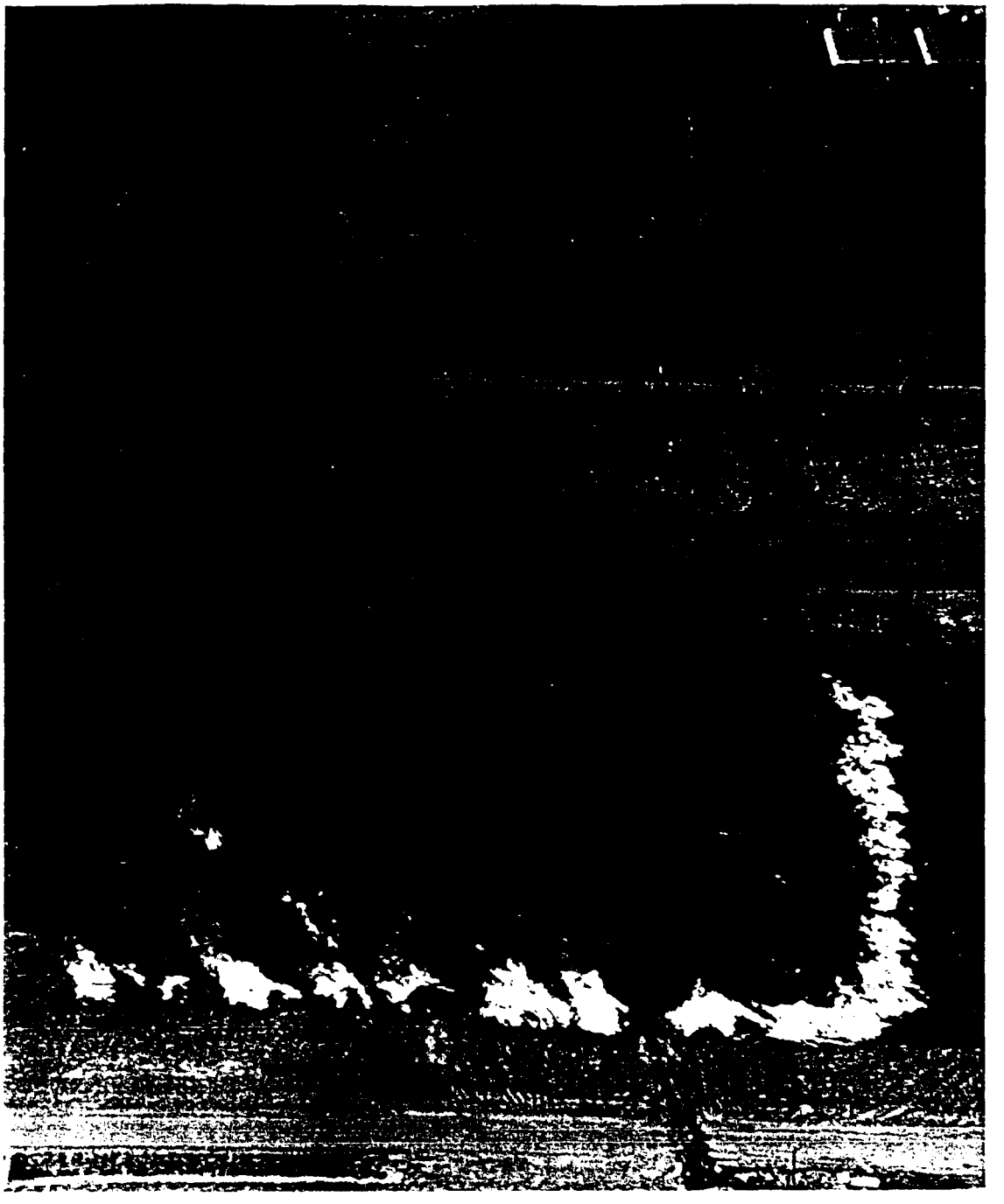
The Summary-Analysis of the Hearings reported "Probably the most significant finding presented to the subcommittee was that civil defense preparedness could reduce the casualties of the assumed attack on the U. S. from approximately 25 per cent of the population to about 3 per cent."

The Laboratory effort in 1960 under the auspices of OCDM was directed toward providing necessary technical information to permit implementing a national shelter program should such a program be initiated.

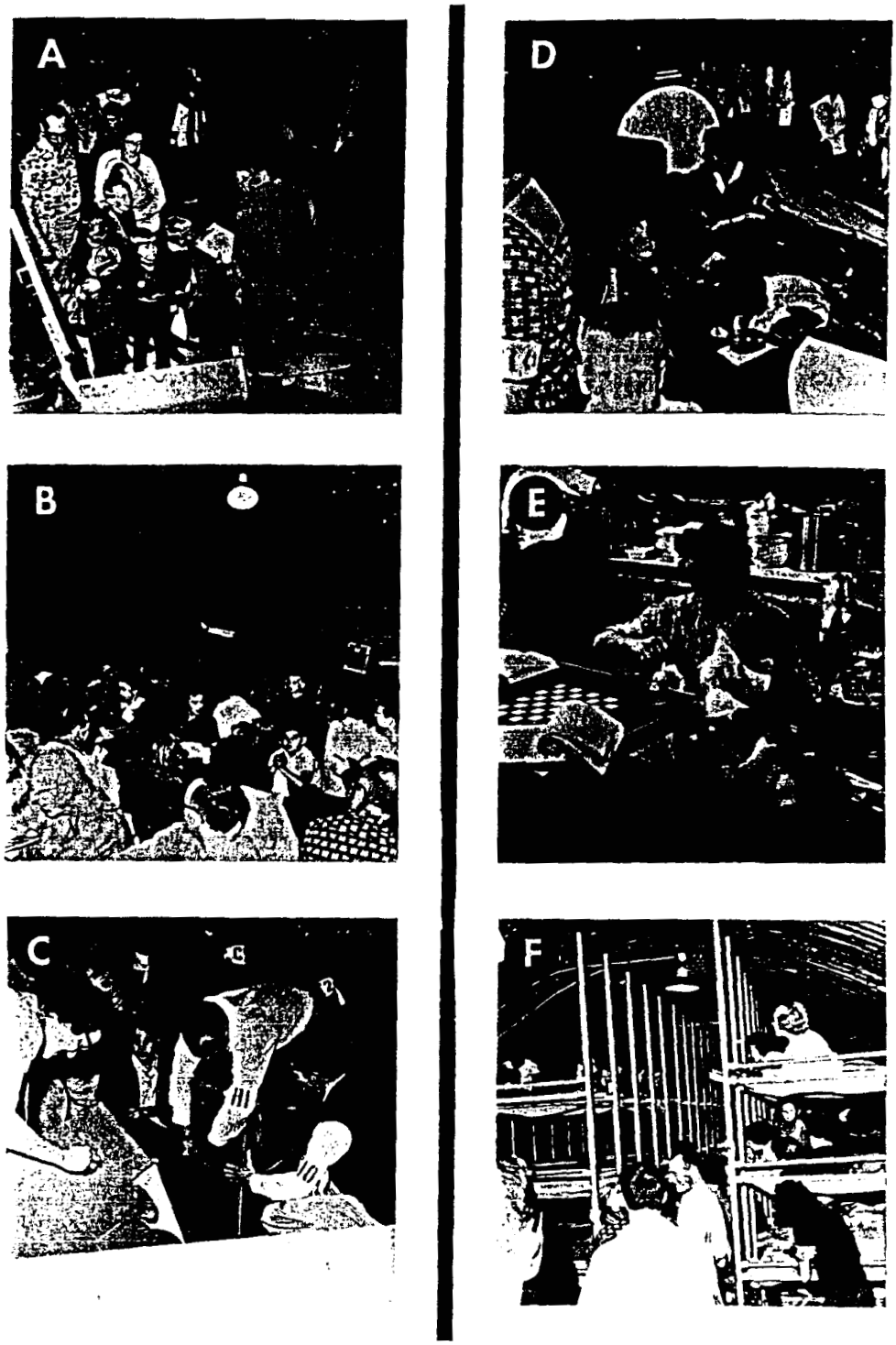
A prototype shelter designed at the Laboratory and constructed at Camp Parks is a corrugated steel-plate circular arch structure, 25'x48', similar to an ammunition storage magazine. It is buried under 3 feet of earth and is entered through an inclined corrugated steel-plate pipe entranceway. Bunks are easily assembled and disassembled and thus may be stored during the non-sleeping hours.

Firestorm

The prototype shelter was successfully tested against a firestorm on 15 April when approximately 500 tons of wood and rubble were burned around it.

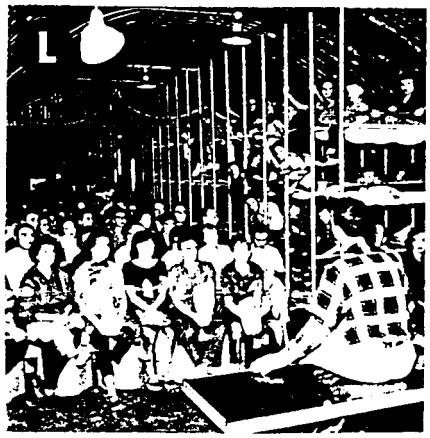


FIRESTORM -- Reputed to be the largest man-made fire ever set for a research project, Operation Firestorm took place at Camp Parks on 15 April 1960. The fire covered an area above and surrounding the shelter to find out what would happen to exposed portions of the shelter and how much heat would register inside.



NATION'S FIRST LARGE-SCALE FAMILY SHELTER TEST, 4-6 NOV. 1960

(A) Let's get started
(B) Sitting back to back before "attack"
(C) Assembling fibreboard chairs
(D) Bunk poles; bags for belongings
(E) Feeding a "wee one"
(F) Bedtime



MORE PICTURES OF THE FAMILY SHELTER TEST

(G) Morning chore
(H) Calisthentics
(I) "Chow" time
(J) Charades
(K) Sick call
(L) Test nears end

Hot Weather Test

A further test of the NRDL-designed survival shelter was conducted 25-29 July as part of the OCDM-sponsored series. The objectives of this test included evaluation of an improved Department of Agriculture boiled wheat diet; assessments of the merits of changed bunk fittings and new cardboard furniture which could significantly reduce outfitting costs; and habitability studies at hot outside temperatures.

100-Person Family Shelter Test

One hundred volunteers, ranging in age from 2 months through 68 years, including representatives of NRDL, OCDM and the California State Disaster Office, participated in a successful 48-hour Family Shelter Test over the weekend of 4-6 November.

This test received extensive new coverage and is the only test known to have been completed with inhabitants in this age range.

WAR GAMING INFORMATION, SIMULATOR, FALLOUT MODEL

RADIOLOGICAL EVENT SIMULATION SYSTEM

Radiation Survey Training sets AN/TDR-T6 and 11Q4A were evaluated in the Laboratory and in the field under a Marine Corps sponsored problem. These sets were intended to simulate a radiological field (radio field strength pattern) for training over a distance of at least ten miles from ground zero, and to provide a means for simulating radiac survey meter response with radio receivers.

A NRDL evaluation showed that neither the AN/TDR-T6 or 11Q4A are suitable for Marine Corps use due to nonreproducibility of meter response in the simulated field and lack of control of the characteristics of the simulated radiological field. The final report of the evaluation suggested methods by which these faults may be corrected.

REPORT ON D-MODEL, USNRDL-TR-410

A fallout-computation method should be based on all the dynamics of the fallout process, but current computation models do not provide more than generalized answers because they do not accout for early-time dynamics. In the attempt to account for the entire process, a theory for close-in fallout was originated. This theory was checked by developing from it a mathematical fallout model for land-surface bursts (the D-Model) and then using this model to compute fallout dose-rate patterns for two low-yield nuclear tests in Nevada. From a comparison of these patterns with the measured test patterns, it is concluded that the theory, as embodied in the D-Model, is sound, at least for low-yield land-surface bursts. Also, preliminary results indicate that the theory can be used to give accurate computations for bursts in the moderate and high-yield ranges.

RADIOLOGICAL TACTICAL SIMULATOR

The design for a device to be called a "Radiological Tactical Simulator" was completed in 1960. The device is being built by the Philco Corporation Western Development Laboratories. The function of the device is to simulate the passage of a target (e.g., a ship or group of soldiers) through a radiological environment; and to determine, record, and display the dynamic radiological experience of the target. Given a specific target maneuver and a prescribed radiological field that varies in both space and time, the simulator will produce as output the time variation of radiation intensity and dose experienced by the moving target. Three component radiations are recognized in producing a transit dose, a region deposit dose, and a target deposit dose. The simulator will apply to each component intensity an attenuation factor to simulate the effects of such countermeasures as washdown, shielding, and decontamination. The simulator will also display the target path relative to the prescribed radiological field with suitable timing marks.

The simulator should permit extensive analysis of tactical maneuvers and ship doctrine in operations involving nuclear events. It could also be used as a training device for officers whose responsibilities might include conning a ship in the vicinity of a nuclear burst.

TECHNICAL BASIS FOR OPERATIONAL DOCTRINE

TRIPARTITE SYMPOSIUM ON TECHNICAL STATUS OF RADIOLOGICAL DEFENSE IN THE FLEETS

A Tripartite (U. S., U. K., and Canada) Symposium on the technical status of radiological defense in the fleets was held at this Laboratory, 16-20 May 1960. This symposium was held for the purpose of improving knowledge of the technical basis of fleet nuclear warfare defense through exchange and discussion of current information among qualified experts of the U. S. Navy, the Royal Navy and the Royal Canadian Navy. The symposium examined the state of knowledge from the scientific viewpoint. Three of the four volumes of the Proceedings of the Symposium have been published. Security review has been completed on the last with publication scheduled for March 1961.

DECISION PROCEDURES FOR SHIPBOARD RADIOLOGICAL DEFENSE, USNRDL-TR-407

This study examines the implications of operating in a nuclear environment. A variety of radiological countermeasures have been introduced aboard U. S. Navy ships to protect personnel from ionizing radiation. Use of these countermeasures can result in temporary reduction of operational capability, requiring command decisions to establish the proper balance between radiological protection and tactical readiness.

This analysis would help the Commanding Officer in deciding where to draw the line between use of radiological protection and acceptance of the decrease in tactical effectiveness of the ship which might result.

PREDICTION OF SHIPBOARD THERMAL COMBAT INEFFECTIVES, USNRDL-TR-427

The vulnerability of topside shipboard personnel to thermal radiation from nuclear weapons is analyzed and reported in USNRDL-TR-427.

A thermal combat ineffective is taken as one whose hands and/or face receives a second-degree burn or greater. This study included analyses of (1) the effective thermal energy required to produce second-degree burns from partial and whole thermal pulses; (2) the distribution and field of view of topside personnel at general quarters on representative DE, DD, CA, and CVA ship types; and (3) the effectiveness of the presently practiced take-cover evasion and a new recommended hands-to-face evasion. Graphs and tables are given to predict "per cent thermal combat ineffectives among topside personnel vs. distance from burst point" for 1-KT to 10-MT air and surface bursts and for no evasion, normal take-cover evasion, and hands-to-face evasion.

SIXTH WESTERN MILITARY OPERATIONS RESEARCH SYMPOSIUM

The Sixth Western Classified Military Operations Research Symposium, sponsored by the Office of Naval Research, was held at the Laboratory on 20 and 21 October. The papers covered a wide range of subjects including "Implications of Nuclear Weapons on Military Operations," "Command and Control," "Human Factors/Man-Machine Studies," and "War Gaming." These were presented by representatives from most of the recognized western organizations working in these subjects.

OPERATIONAL CAPABILITY FOR RADIOLOGICAL CONTAMINATION CONTROL

RADCON TEAM

Improvement in Radiological Control (RADCON) Team Readiness

During 1960 the general readiness of the RADCON Team to deploy and render assistance at a nuclear accident site was considerably improved. A general RADCON Review was conducted to analyze the current status of the RADCON Team, with particular emphasis upon the validity

of its procedures, the soundness of its organization and equipment,and the optimum level of training desired. This was followed by a number of personnel changes, procedure changes, and a complete renovation of the Team equipment and its Ready Room. Obsolete equipment was removed and new equipment added. Improved maintenance routines were set up for all items. Additional funds were obtained from BUSHIPS to increase the maintenance level of the equipment and to outfit all Team personnel with cold weather clothing.

RADCON Drill

On 14 April the NRDL RADCON Team participated in a RADCON exercise at Naval Ammunition Depot, Concord, California. The NAD Disaster Control organization rapidly accomplished emergency phase fire-fighting and EOD tasks. The RADCON Team deployed from the Laboratory with 3500 pounds of equipment in less than one hour after notification; and reported to NAD, Concord, in less than two hours after notification, ready to assist in radiological recovery operations.

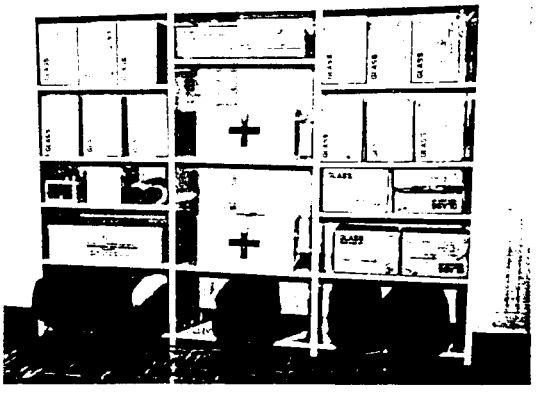
Radiological Incident

The Laboratory rendered assistance in connection with an accidental spill of a small amount of radium salt on a laminating machine at the Naval Supply Depot, Oakland. The incident caused concern to several employees about possible harmful effects of the radium to them. The problem was more psychological than real and NRDL participation in the clinical and laboratory examinations helped reduce any adverse impact.

Radiological Safety Aspects of Nuclear Weapons Stowage

Dr. C. R. Schwob was commended by the Chief, Bureau of Ships, for his outstanding presentation on this subject. The letter stated in part that the presentation, made in Washington on December 14, 1959 to U. S. and U. K. representatives, was instrumental in gaining support for a program of immediate importance to the Bureau of Ships and the Chief of Naval Operations.

RADCON DRILL -- Members of the NRDL RADCON Team engaged in an exercise at NAD, Concord, California. (below) Supplies in the RADCON Ready Room



Hazard Analysis, Pacific Missile Range

A study is underway to evaluate radiological hazards associated with operation of nuclear-powered vehicles and satellites at Pacific Missile Range. The study is intended to help provide criteria for site development, operational procedures, and range safety considerations.

Principles of Radiation and Contamination Control (NAVSHIPS 250-341-3)

This series of three volumes was published in 1960 and has received favorable comment as an important addition to the literature on this important area.

Volume I, RADSAFE for Everybody, is for persons working where there is radiation or using radioactive materials. It contains a general introduction to the physics of radiation and the biological effects that make it dangerous to health, together with techniques for measuring radiation and minimizing the chances that it will injure anyone. It should by itself meet many essential requirements. Volume II, Procedures and Guidelines Relating to Nuclear Weapon Effects, is for those with special responsibility in regard to radiation, relating to nuclear weapon effects. It develops in more detail the elements given in Volume I. Volume III, Technical Information Relating to Nuclear Weapons Effects, contains data needed to conduct training courses for which Volume II might serve as a textbook. It is a basic and fundamental reference for Volumes I and II.

INDUSTRIAL APPLICATIONS

PARTICIPATION IN CONGRESSIONAL HEARINGS

Once again in 1960 the Laboratory participated to a significant extent in Hearings of the Joint Committee on Atomic Energy. The subject of the sessions during May 24 to June 4 was Radiation Protection Criteria and Standards: Their Basis and Use. A statement was prepared by the Laboratory for the Committee as requested. In addition, Dr. R. R. Newell, Medical Consultant to the Laboratory, submitted a separate statement.

MEET THE AUTHORS OF PORACC -- From left, R. A. Sulit, E. J. Leahy, and A. L. Baietti

WRIST-TYPE MAGNETIC COMPASSES

Tests were conducted to determine if a radiological health hazard exists in use, handling, and storage of a redesigned wrist-type magnetic compass with radioactive dial markings. It was determined that the compass did not meet the specifications.

DISPOSAL OF RADIOACTIVE WASTES

The problem of disposal of radioactive wastes continued to receive close scrutiny at the Federal and State levels. NRDL furnished comments to the Chief of Naval Operations concerning a proposed SECNAV Instruction, "Disposal of Packaged Radioactive Waste Material."

NRDL consulted with and advised the AEC through the San Francisco Operations Office in connection with tests of various types of containers used for disposal of radioactive wastes at sea.

REGISTRATION OF SOURCES

NRDL made recommendations to the Chief of Naval Operations concerning implications of State requirements for registration of radiation sources.

POLARIS FLAW DETECTION SYSTEM

NRDL, in collaboration with NOTS, China Lake, is working on development of an instantaneous flaw detection system for solid propellant rocket motors. One hundred per cent inspection of these motors is generally required to insure their performance, safety and reliability. Conventional radiographic techniques are laborious, costly, and time consuming requiring the development of faster and more inexpensive techniques. A new system is being tested at NRDL.

CHAPTER III -- PUBLICATIONS

REPORTS AND MEMORANDA

The following types and numbers of reports were issued in 1960:

U. S. Naval Radiological Defense Laboratory Reports (Formal).	3
Technical Reports (USNRDL-TR)	111
Technical Memoranda (TM)	7
Progress Reports (P)	5
Evaluation Report (ER)	1
Reviews and Lectures (R and L)	14
Total	141

PUBLICATION IN THE OPEN LITERATURE

Scientists of NRDL had 68 papers and articles published in over 30 journals during 1960.

MISCELLANEOUS PUBLICATIONS

Ray Alger, Head of Radiation Effects Branch, authored the Chapter on "Trapped Radicals in Radiation Damage" for the book FORMATION AND TRAPPING OF FREE RADICALS, published by Academic Press.

Dr. P. C. Tompkins, Scientific Director, published an article in the PROCEEDINGS OF THE U. S. NAVAL INSTITUTE entitled "Some Implications of the Nuclear Threat in Relation to National Policy." The article refutes a fatalistic attitude reflected in Neville Shute's "On the Beach."

Principles of Radiation and Contamination Control (see page 39)

Command History of the Naval Radiological Defense Laboratory for 1959

PATENTS

Two patents were issued: W. B. Lane, Radioactive Ignition System Patent #2920238; and Alfred Schmidt, Internal Retaining Ring, Patent #2935345. Eight applications for patents were filed with the Patent Bureau by BUSHIPS Patent Attorney on behalf of Laboratory personnel. Eleven disclosures of inventions were filed with the BUSHIPS Patent Attorney.

CHAPTER IV
AWARDS - COMMENDATION - HONORS

DOD DISTINGUISHED CIVILIAN SERVICE AWARD

In January Dr. P. C. Tompkins, Scientific Director, received the Secretary of the Navy's Distinguished Civilian Service Award, the highest honor the Navy bestows upon a civilian employee. Less than three months later he received the Department of Defense Distinguished Civilian Service Award, the highest honor conferred on civilian employees by DOD. It was stated in the citation that "Under Dr. Tompkins' leadership the NRDL has become, in effect, a national institute for nuclear effects research."

NRDL AWARD FOR SCIENTIFIC ACHIEVEMENT

Dr. Siegmund J. Baum, Biological and Medical Sciences Division, won the first annual NRDL award for Scientific Achievement "for conceiving an establishing an original mathematical formulation for residual injury to the erythropoietic system." Others commended were Albert D. Anderson, Military Evaluations Division, for the development and application of the NRDL dynamic model (D-model) for predicting fallout from land-surface nuclear explosions; and Francis M. Tomnovec, Nucleonics Division, for his contributions to determine the neutron penetration into the various types of soil and the neutron induced radioactivity in these soils.

PFIZER AWARD OF MERIT

Captain H. S. Etter, MC, USN, Radiological Medical Director, received the Pfizer Award of Merit at the 9th annual U. S. Civil Defense Council conference at Minneapolis, Minn. The award cited Dr. Etter for meritorious service to the people of the U. S. and the Medical-Health professions for his endeavor in the field of Radiological Warfare Defense.

NRDL FELLOWSHIP

The first NRDL Fellowship was awarded to E. C. Evans III for one year's study and research in radio-ecology at the University of California.

GENERAL AWARDS

Superior Accomplishment cash awards totaling $2,000 were presented to 13 civilians, including one who received the "Outstanding" performance rating for the year. Four military men received Good Conduct medals and four received Meritorious Mass awards.

One hundred and thirty-four Beneficial Suggestions were submitted by NRDLERS and 25 were accepted for a total monetary award of $300 (22 for intangible benefits and three for tangible).

The Laboratory won the Secretary of the Navy's Certificate of Achievement in Safety for both industrial and vehicular low accident frequency rate. Four members of the Transportation Branch earned special Safe-driving pins for accident-free driving.

The Merit Promotion Program advanced 25 members of different Laboratory units to higher grades, while promotions from re-description of duties were received by 90.

One employee earned a 30-year service pin; five received 20-year service pins.

MISCELLANEOUS HONORS

Research Fellowship in England

Dr. M. S. Silverman, Experimental Pathology Branch, received a Special Research Fellowship for one year from the National Cancer Institute of the U. S. Public Health Service. He will work at Guy's Hospital Medical School, London, England, with Dr. P. A. Gorer, a world authority on tissue transplantation and cancer immunity.

DR. P. C. TOMPKINS -- Recipient of two Distinguished Civilian Service Awards -- one from DOD, the other from the Navy Department

DR. S. J. BAUM (above) RECEIVES FIRST NRDL AWARD FOR SCIENTIFIC ACHIEVEMENT

DR. H. S. ETTER (below) RECEIVES PFIZER AWARD

AAAS Fellow

Dr. J. D. Teresi, head of the Hazard Evaluation Branch, was named a Fellow of the American Association for the Advancement of Science.

Heart Association

Dr. R. W. Brauer, head of the Pharmacology Branch, was appointed to the Board of Directors of the San Mateo Heart Association.

CHAPTER V
SEMINARS -- SYMPOSIA -- CONFERENCES

MEETING AT NRDL

Three Scientific Director's Colloquia were held, along with regular seminars by individual branches of the Scientific Department. NRDLERS and guest scientists participated in presenting these seminars. Monthly technical meetings as well as separate leadership seminars of all NRDL officers were continued with members of the Laboratory staff giving talks on various facets of their work.

The Laboratory contributed to the success of the 5th course in Atomic, Biological, and Chemical Defense Course for Medical Officers. (see page 18) Other meetings held at the Laboratory were: Ship Structures Committee of the U. S. Coast Guard; Inter-Laboratory Subcommittee on Computers; Inter-Laboratory Committee on Personnel Administration; Policy Board for the Board of Civil Service Examiners for Scientists and Engineers; Coordinators of Medical Education for National Defense; Tripartite (see page 35); Inter-Laboratory Committee on Facilities; 6th West Coast Classified Military Operations Research Symposium (see page 36); Shielding Symposium (see page 21).

MEETINGS ELSEWHERE

As in the past members of NRDL participated in many technical society meetings at home an abroad and presented papers on most occasions. A cross-section of professional meetings at which NRDL members were in attendance includes:

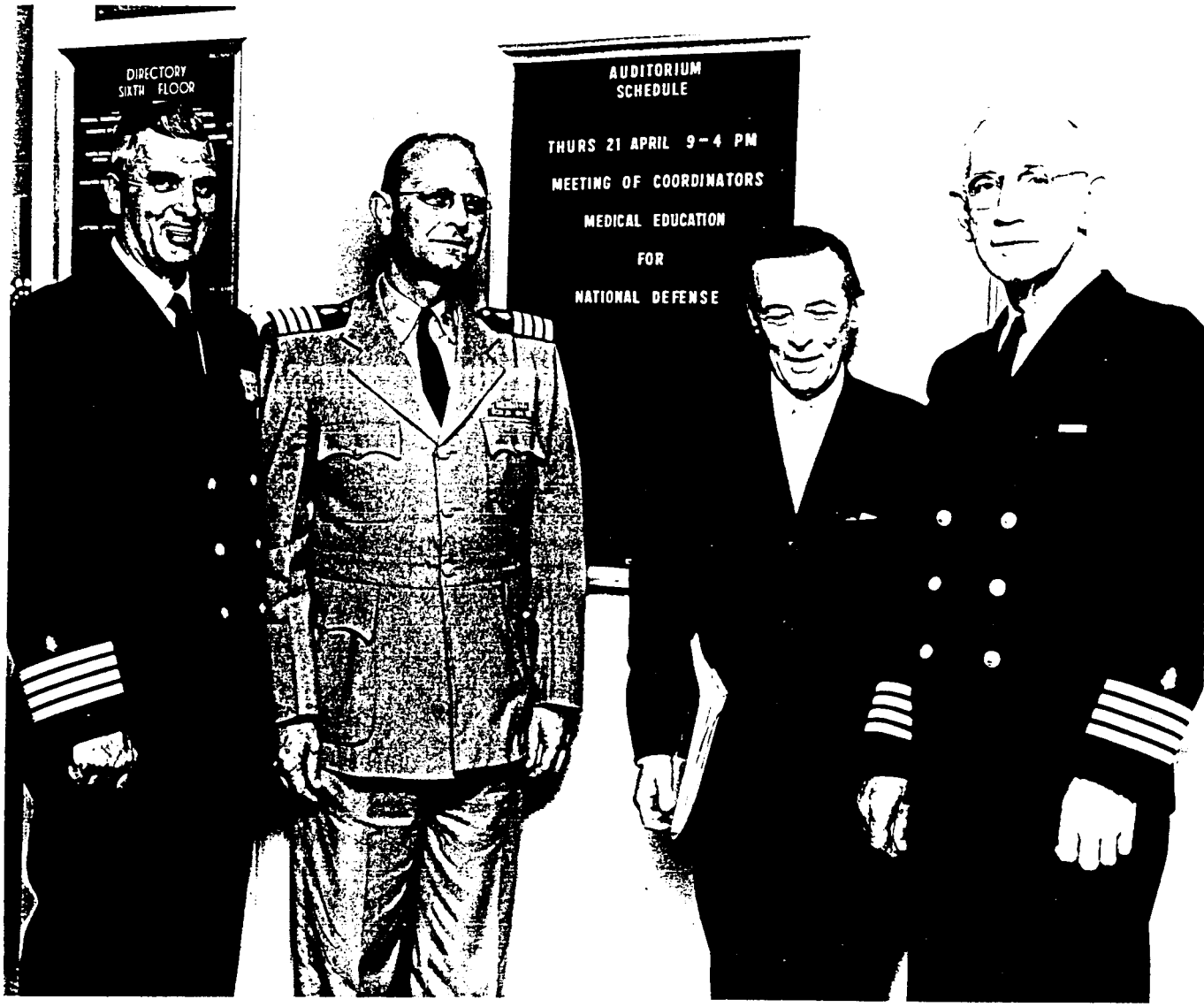
Instrument Society of America; 7th Scintillation Counter Symposium; State Medical Library Association; Federation of American Societies for Experimental Biology; Conference on Occupational Safety; National Institutes of Health; American College of Physicians; American Chemical Society; American Academy of Applied Nutrition; AMA Medical Civil Defense Conference; Radiation Research Society; Thermal Panel of the Future Weapons Requirement Board; Management Problems of Military (RDT and E); Society for Experimental Biology and Medicine; American

College of Surgeons; International Gerontological Congress; American Physiological Society; 5th International Congress on Nutrition; International Symposium on the Response of the Nervous System to Ionizing Radiation; 29th Symposium on Shock, Vibration and Associated Environment; meeting on Coatings for the Aerospace Environment; meetings of the POLARIS/MINUTEMAN/PERSHING Non-Destructive Test Committee; 3rd Symposium on Nuclear Radiochemistry at Chalk River, Canada; 8th Tripartite International Hematological Congress, Tokyo, Japan; 15th Tripartite Conference on Toxilogical Warfare, England; American Nuclear Society; 46th annual meeting of the Radiological Society of North America; 2nd annual Bendix Mass Spectrometer Users Symposium; Thermal Radiation Transfer Through the Atmosphere; and Industrial Editors.

Laboratory personnel also spoke publicly on numerous occasions in the San Francisco Bay Area to such organizations as churches, hospitals, Naval Reserve Units, Marine Corps Association, Peninsula Science Fair, Alameda County Institute of Education, service clubs and college alumnae.

At the International Gerontological Congress mentioned earlier, Dr. R. W. Brauer, Head of Pharmacology Branch, was appointed chairman of a committee to look into the effect of variations of the environment and the biology of animals employed in long term experiments, in particular, those involved in studies of aging, of the late effects of radiation, or in studies of chronic toxicity of drugs.

Dr. W. E. Kreger, Head of the Nuclear Radiation Physics Branch, assumed chairmanship of the Policy Board for the Board of Civil Service Examiners.



COORDINATORS FOR MEDICAL EDUCATION AND NATIONAL DEFENSE AT NRDL -- From left, Captain T. J. Canty, head of Amputee Service, Oak Knoll Naval Hospital; Captain H. S. Etter, Radiological Medical Director at NRDL; Dr. Bennett Woodhall, Dean of the Medical School, Duke University; and Captain Avery, BuMed Coordinator for MEND.

CHAPTER VI -- TRAINING

During 1960 the Laboratory sponsored the following "In-House" training courses: Interaction of Radiation with Matter; Vacuum Technology; Practical Microscopy; and "Fortran" Programming for the IBM 704 currently scheduled for installation early in 1961. NRDL personnel also participated in the course Personnel Management for Executives, held in Berkeley.

Fifty-two employees attended 41 courses in a wide variety of technical subjects at universities in the area. Many of these people who are working for advanced degrees are sponsored by the Laboratory. Two received Ph. D. degrees in 1960.

Continuing activity in these programs, 18 Co-Op student trainees, 8 part-time students and 20 summer employees worked at the Laboratory during the year.

Enlisted personnel were given an average of 11 hours of instruction each month in many subjects, such as, leadership, first-aid, Atomic Biological Chemical Warfare, etc. Of the 38 enlisted personnel on board, 12 were advanced in rate and three were assigned Proficiency Pay 1 as a result of service wide examinations.

CHAPTER VII -- VISITORS

In 1960 the number of visitors totaled 8,930. A few of the distinguished guests were:

Chief of Naval Operations, ADM Arleigh Burke; Chief of Naval Research, RADM Rawson Bennett; Assistant Secretary of the Navy (R and D), Honorable J. H. Wakelin; Assistant Secretary of the Navy (Material), Honorable C. P. Milne; Deputy and Assistant BUSHIPS Chief and Assistant Coordinator of Shipbuilding Conversion and Repair, RADM R. L. Moore, Jr.; Assistant Secretary of Defense (Health Medical), Honorable Frank B. Berry, and eight members of his Civilian Health and Medical Advisory Council; Assistant Director of Defense Research and Engineering (Naval Weapons), Mr. Frank A. Parker; members of the BW/CW Defense Planning Board, Office of the Assistant Secretary of Defense; Commander Field Command,DASA, MAJGEN L. T. Heath, and his deputy, RADM Courtney Shands, and Navy Deputy, Field Command, DASA, RADM J. D. Black.

Also, members of the National Research Council headed by Dr. Richard Kern, professor emeritus medicine, Temple Medical School; Assistant Chief of the Bureau of Medicine and Surgery for Research and Military Medical Specialties, RADM Calvin Galloway; Assistant to the Secretary of Defense and chairman of the Military Liaison Committee (DOD-AEC), Honorable H. B. Loper, and about 20 MLC members; Navy League; Chief Scientist of BUSHIPS, Dr. R. C. Sponsler; Scientific Liaison Officer from the ONR Branch Office, London, CAPT J. H. Stover, Jr.; Mr. R. E. Wiley, Office of Research Coordination, ONR, Washington, D. C.; and CAPT M. D. Norton, Commanding Officer of the Nuclear Weapons Training Center Pacific.

As part of President Eisenhower's People to People Program, a group of Senior Friendly Allied Officers from Japan, Peru, Free China, Greece, Burma, and Indonesia visited the Laboratory. Other foreign military visitors included ADM Jorge da Silva Leite, Chief of the Brazilian Navy General Staff; RADM Juna Francisco Torres-Matos, Commanding General of the Peruvian Navy; RADM Gaston C. Clement, Secretary of the Navy of Argentina; ADM NI Yue-si, Commander in Chief, RADM HUANG Ksi-lin, and RADM TWAN Yun-ling, Republic of China Navy; and VADM Refet Arnom, Turkish Fleet CinC. Many eminent scientists visited from the U. S. and Australia, Belgium, Canada, England, France, Holland, Israel, Italy, Norway, Poland, Sweden, Switzerland and Thailand.

ADMIRAL ARLEIGH BURKE, Chief of Naval Operations Arrives at NRDL on 4 March 1960. He is accompanied by Captain J. S. McQuilkin, at that time Commanding Officer and Director.

SENIOR OFFICERS OF FRIENDLY ALLIED NATIONS VISIT NRDL AS PART OF PEOPLE TO PEOPLE PROGRAM -- This picture shows them listening to the Commanding Officer and Director, Captain E. B. Roth, explain the mission of the Laboratory. They are, from left, Commander Athanassios Epthimiou, Greece; Commander Thein Han, Burma; Captain Chushire Sato, Japan; Lieutenant Necat Erdibil, Turkey; Lieutenant (j.g.) Ergun Tuncel, Turkey; Lieutenant Nguyen Huu Tieng, Vietnam; Captain Jose R. Zulueta, Philippine Islands; Lieutenant Gunay Aktay, Turkey; Commander Yi Tae Won, Korea; Captain Raul Pooley Paez, Peru; and Captain Lee Liang-chi, Free China. Not pictured: Major Marsoni, Indonesia; and Lieutenant Yasar Karaboga, Turkey. The four Turkish Navy officers are spending one year at the San Francisco Naval Shipyard working in various departments. The others spent 10-12 weeks in this country visiting various Naval and other installations, particularly shipyard.

CHAPTER VIII -- PUBLICITY

DAILY PRESS

The daily press throughout the country gave wide coverage to the Nation's first large-scale test of family living in a nuclear age -- the 48-hour underground shelter test conducted by this Laboratory 4-6 Nov. In fact, all of the field tests drew good press, radio and TV coverage, including the July shelter test, Firestorm, detonation of high explosives at Camp Parks Firing Pond, the decontamination studies, and the flashing light experiment in Los Angeles. Other publicity included change of command, promotions, honors and awards and participation in important scientific meetings.

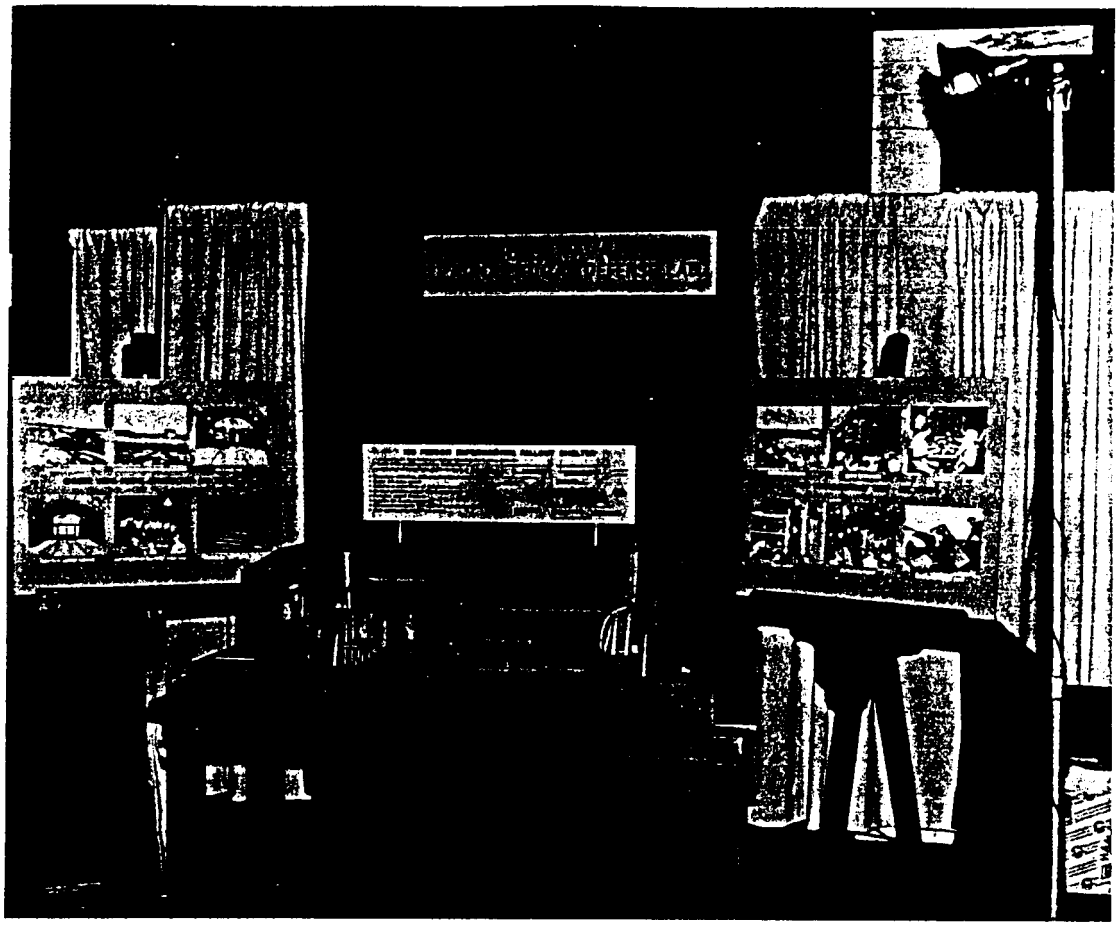
TV and RADIO

In addition to TV and radio news coverage of the field tests, Don Schultze, assistant shelter commander, appeared as a guest on KTVU's Captain Satellite Program.

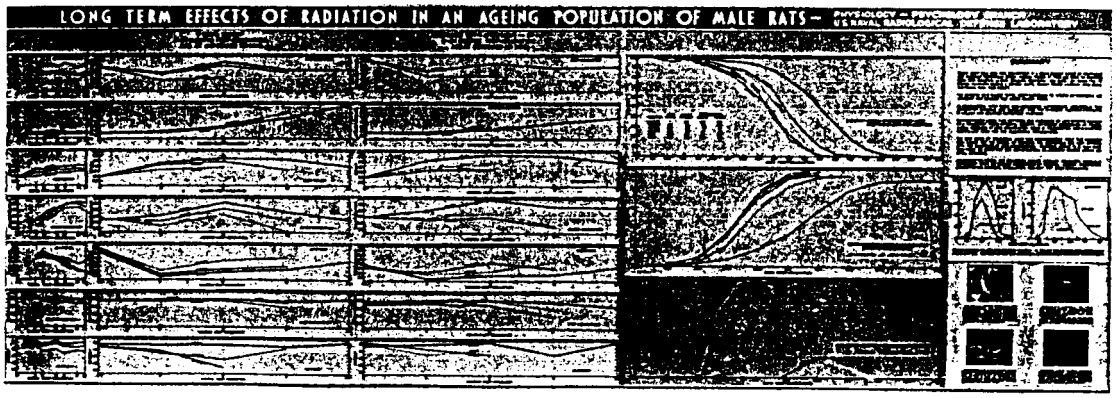
Dr. E. J. Kimeldorf, Head of Psychology-Physiology Branch, appeared on a Chicago radio program following presentation of his paper at the International Symposium on the Response of the Nervous System to Ionizing Radiation. His statement that "exposure of as little as 10 roentgens of gamma radiation changes the behavior of rats" also attracted the attention of science writers and made wire service headlines.

MISCELLANEOUS

Two new exhibits were added: a model of the shelter, which was displayed at the AMA Convention in Miami, Fla., and at the 4th Western Industrial Health Conference, San Francisco, and a display of Long-Term Effects of Radiation in an Ageing Population of Male Rats. This latter exhibit was one of 11 (out of 61) receiving an award at the 46th annual meeting of the Radiological Society of North America, held in Cincinnati, Ohio.



SHELTER MODEL



LONG TERM EFFECTS OF RADIATION IN AN AGEING POPULATION OF MALE RATS

CHAPTER IX -- MISCELLANEOUS

The design and selection of the logotype (at left) involved a long consideration of the mission and work at NRDL. It was adopted because it best interpreted the many kindred scientific activities of the Laboratory. It is symbolic of the atom, and of man and shelter, of shielding and of instrumentation. It represents the contemporary stature of the Laboratory. Since its adoption, the logo has become the identifying symbol -- of NRDL. It has been reproduced for use as identification for instruments, dials, plant and heavy equipment.

A Scientist-in-Residence Committee, organized this year, hopes in 1961 to execute its plan to bring eminent scientists to NRDL for limited periods to conduct research of superior quality.

A Sigma Xi Club was formed at NRDL during 1960 and the Scientific Director, Dr. Eugene P. Cooper, was elected president.... On 2 February the first official transmission was made from the NRDL Amateur Radio Station, W6SFT.... Women Employees of NRDL held a County Fair and assisted in other special events.

LOOKING FORWARD

Nineteen-sixty marked the second full year of research effort since initiation of the nuclear weapon test moratorium. However, there has been no diminution of the Laboratory's effort in pursuing its mission. A full program is foreseen over the next several years whether or not tests are resumed. NRDL's future looks bright as a key research laboratory to help solve the problems of "living with the atom."